Human Perception Tidbits

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Human perception

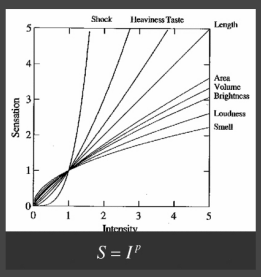
sensors/transducers
- psychophysics: determine characteristics

relative judgements: strong
absolute judgements: weak

different optimizations than most machines
- eyes are not cameras
- perceptual dimensions not nD array
- (brains are not hard disks)

Nonlinear perception of magnitudes

sensory dimensions not equally discriminable
- JND: Just Noticeable Differences
- Stevens power law



$$S = I^p$$

[Stevens, On the Theory of Scales of Measurement, Science 103:2684, 1946]

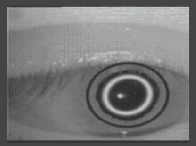
Limits of intuition

thoughts, goals, plans: accurate
vision, hearing, attention, memory: inaccurate

Eyes

foveal vision
- high resolution
- thumbnail at arm's length

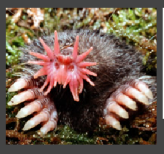
saccades [video]
- high-resolution samples, brain makes collage
- vision perceived as entire simultaneous field
- dwell 200-600ms, moving: 20-100ms

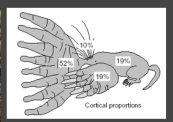


[vision.arc.nasa.gov/personnel/jbm/home/projects/osa98/osa98.html/

Fovea

low-res periphery, high-res sensor
- general concept, not just for eyes
- foveal touch!: star-nosed mole





[www.nature.com/nsu/010329/010329-6.html
brain.nips.ac.jp/event/work131030/Catania_and_Kaas,_1997.pdf]

Ears

perceived as temporal stream
- but also samples over time
- hard to filter out when not important
  visual vs auditory attention

implications
- harder to create overview?
- hard to use as separable dimension?

'sonification' still very niche area
- alternative: supporting sound enhances immersion

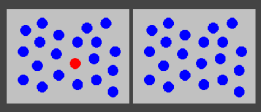
Attention

change blindness
- change requires attention
- Ron Rensink
- http://www.psych.ubc.ca/~rensink/flicker/

basketball video
- count number of passes out loud

Preattentive visual dimensions

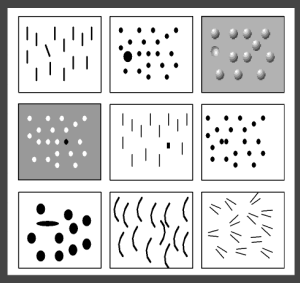
color (hue) alone: preattentive
- attentional system not invoked
- search speed independent of distractor count



[Chris Healey, Preattentive Processing, www.csc.ncsu.edu/faculty/healey/PP/PP.html]

Preattentive visual dimensions

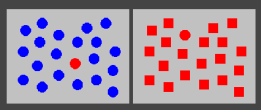
many preattentive dimensions of visual modality
- hue
- shape
- texture
- length
- width
- size
- orientation
- curvature
- intersection
- intensity
- flicker
- direction of motion
- stereoscopic depth
- lighting direction



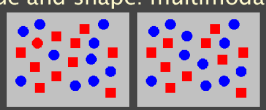
[Chris Healey, Preattentive Processing, www.csc.ncsu.edu/faculty/healey/PP/PP.html]

Preattentive visual dimensions

color alone: preattentive
shape alone: preattentive



combined hue and shape: multimodal



- requires attention
- search speed linear with distractor count

[Chris Healey, Preattentive Processing, www.csc.ncsu.edu/faculty/healey/PP/PP.html]

Well, actually...

sometimes works (motion + color)

but need both preattentive and cognitive
- for, say, designing visualizations

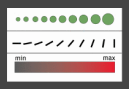
Integral vs. separable dimensions

red-green yellow-blue | x-size y-size | size orientation | color shape | color motion | color location

[Colin Ware, Information Visualization: Perception for Design. Morgan Kaufmann 1999.]

Data types

continuous (quantitative)
- 10 inches, 17 inches, 23 inches



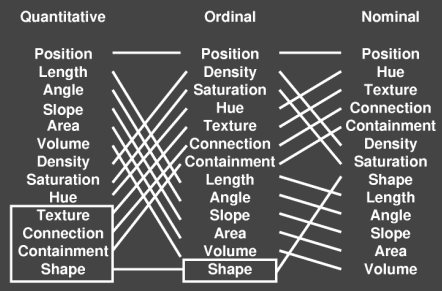
ordered (ordinal)
- small, medium, large

categorical (nominal)
- apples, oranges, bananas

[graphics.stanford.edu/papers/polaris]

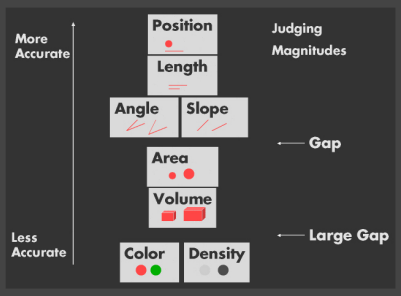
Dimensional ranking varies by data type

spatial position best for all types



[Mackinlay, Automating the Design of Graphical Presentations of Relational Information, ACM TOG 5:2, 1986]

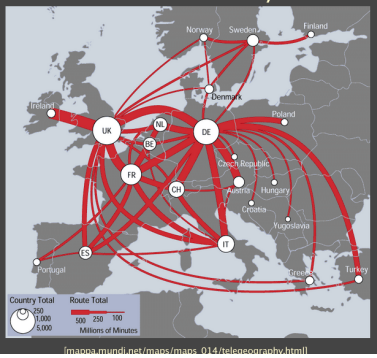
Dimensional ranking



[graphics.stanford.edu/courses/cs448b-02-spring/lectures/encoding/walk015.html]

Dimensional dynamic range

linewidth: limited discriminability



[mappa.mundi.net/maps/maps_014/telegeography.html]